**Automatic principal component based lung lobe segmentation from computed tomography scans**

Zhang, Y.1, Osanlouy, M.1, Clark, A.R.1, Hoffman, E.A.2, Tawhai, M.H1

1Auckland Bioengineering Institute, University of Auckland, Auckland, NZ, 2Department of Radiology and Biomedical Engineering, University of Iowa Carver College of Medicine, Iowa City, IA, US.

Human lungs are divided into five distinct anatomical regions, the pulmonary lobes. Automatic identification of lobes from imaging is important in lung disease assessment and treatment planning. However, quick and effective automatic lobe segmentation is a challenging task. The fissures that separate the lobes can be incomplete, and areas of lung disease can make these fissures hard to distinguish. Currently, lobe segmentation methods rely heavily on anatomic knowledge and largely ignore individual variability. This results in regular segmentation failure in pathological lungs, and in expiratory CT (computed tomography) scans, where fissure locations are difficult to distinguish.

In this study, we use a statistical shape model (a principal component model) to guide lobar segmentation. By deforming an average lobar model onto an individual’s lung shape, we predict fissure locations approximately, to refine our search region for lobar structures. Then, we use an eigenvalue of Hessian matrix analysis and a connected component eigenvector based analysis to determine a set of fissure-like candidate points. A smooth multi-level B-spline curve is fitted to the most fissure-like points (those with high “fissureness”) and the fitted fissure plane is extrapolated to the lung boundaries. The method was tested on 20 inspiratory and expiratory CT scans in healthy young subjects and older subjects with idiopathic pulmonary fibrosis. Slice thickness was 0.5-3.0mm, with the higher end of this scale representing normal clinical imaging. A quantitative evaluation showed that the algorithm has accuracy of 72.5% to 92.6% for healthy cases and an accuracy of 53.8% to 85.7% for pathological cases with strict 3mm evaluation criteria. The algorithm was able to detect fissures in all subjects, whereas existing segmentation tools failed in several subjects. Our new procedure does not depend on prior segmentation of anatomical structures (airways/vessels) and has promising potential as a clinically useful automatic lobe segmentation procedure.